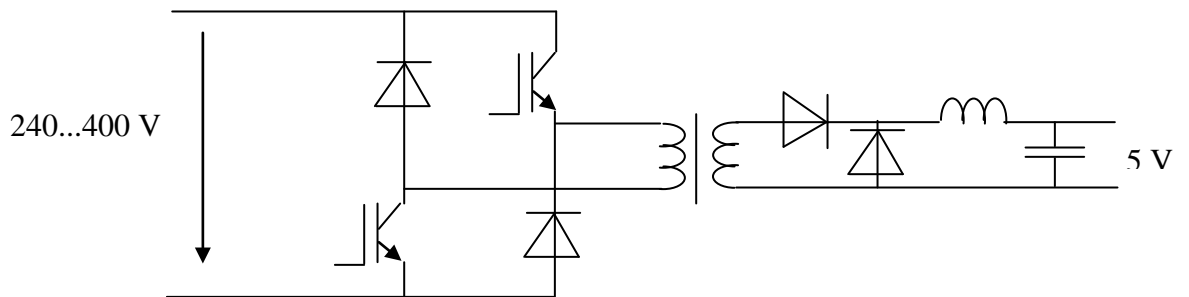


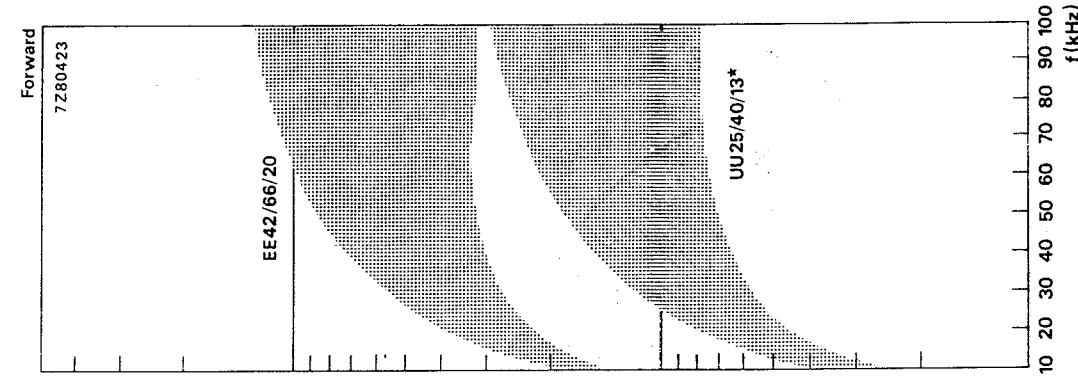
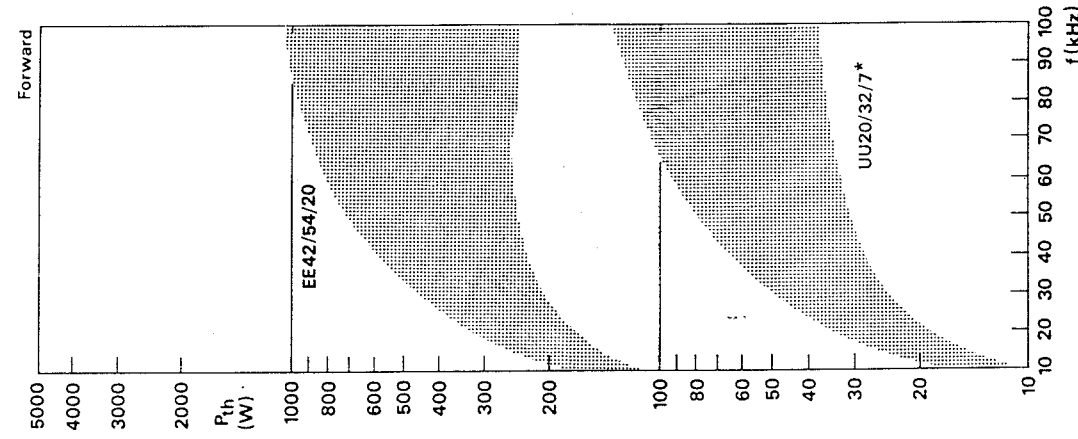
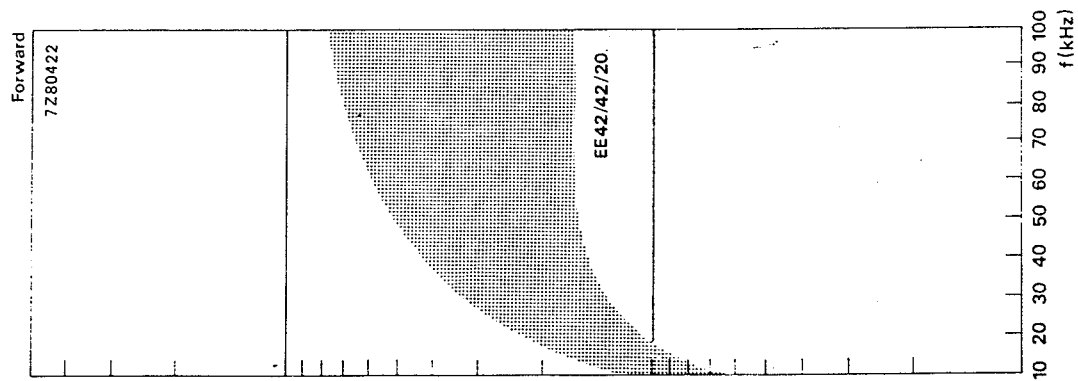
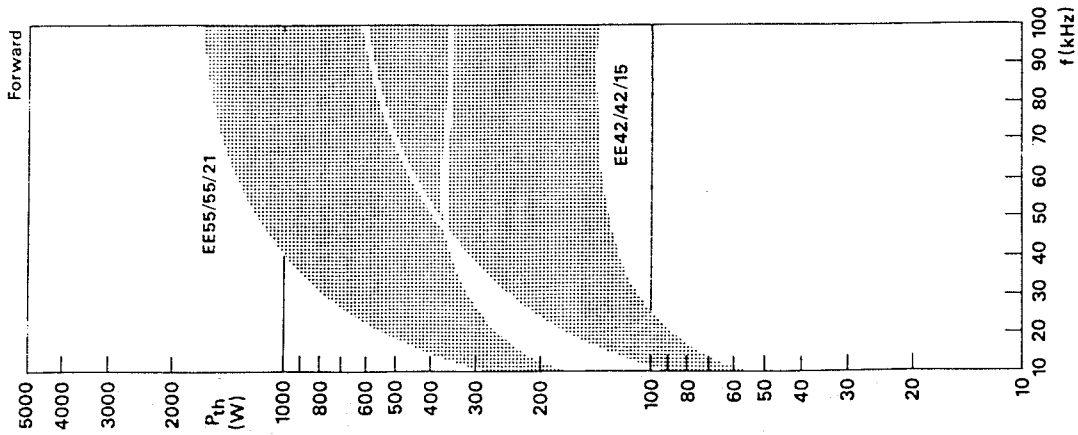
ELEC-E8421 Tehoelektroniikan komponentit

Harjoitus 8.

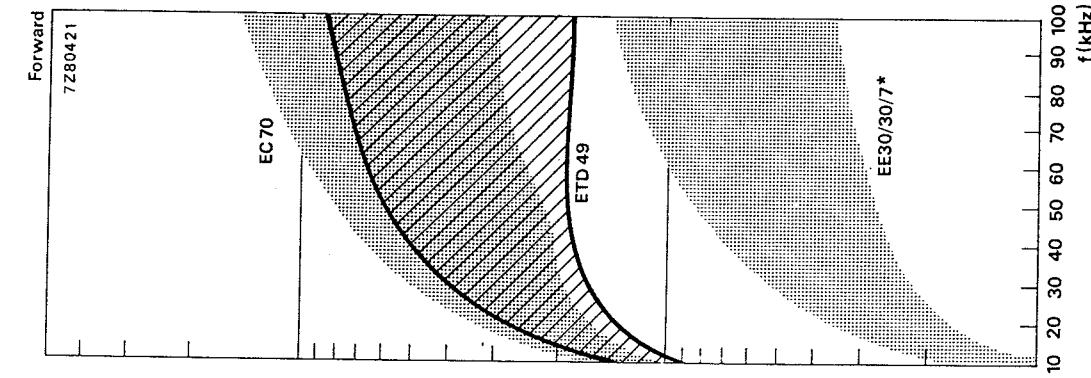
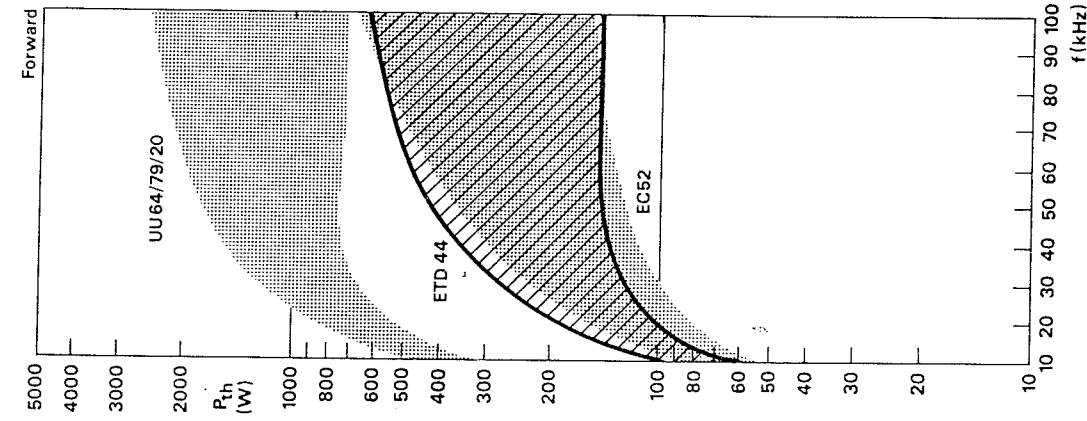
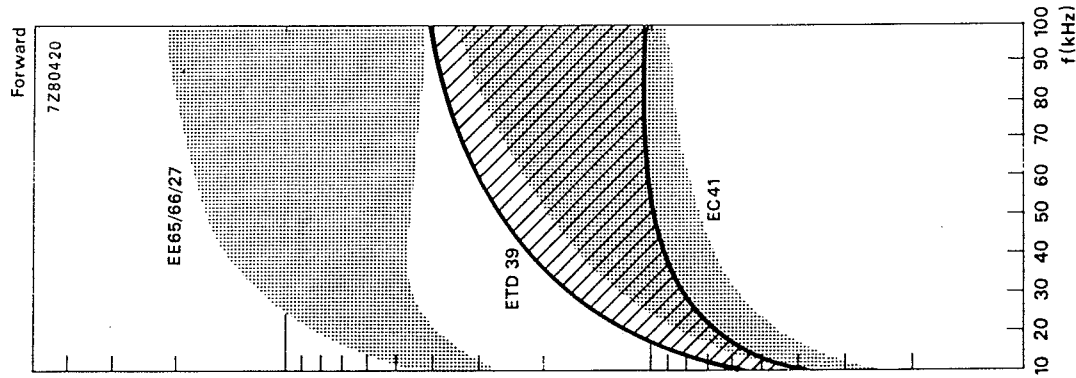
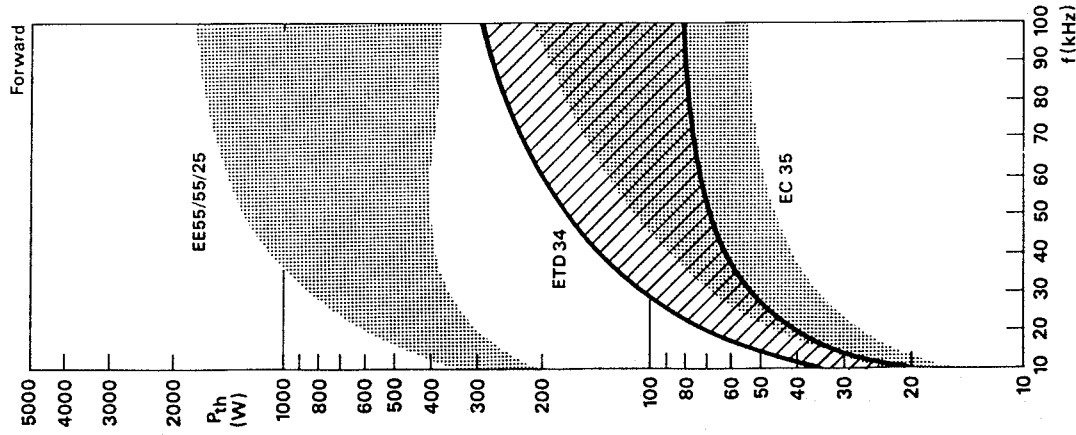
1. Figure depicts forward type SMPS, 25 kHz switching frequency is used to convert 300 V (ranging from 240-400 V) to +5 V, 30 A. Using following brochure find suitable transformer cores, when 8 mm creepage is required for safety.



2. Dimension the windings for previous forward-smps transformer, when core is ETD 49. Highest allowed temperature in the core is 100 C. Static protection is 0.1 mm copper foil, Main insulation is 0.15 mm thick. Layer insulation is 0.1 mm. What is highest environmental temperature. Assume semiconductor conduction losses to be 1 V. and transformer leakage inductance commutation loss to be 10 %.



* Without creepage allowance.

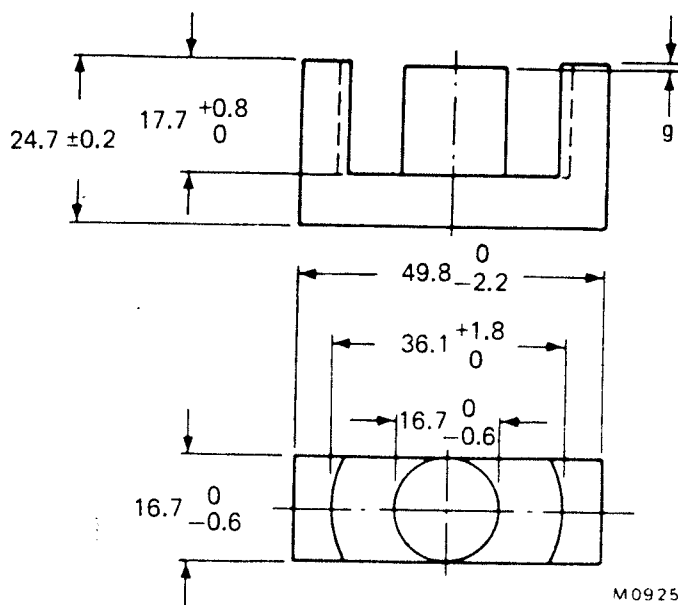


* Without creepage allowance.

Philips

ETD49 SYSTEM

FERROXCUBE CORE



Material: Ferrocube grade 3C8

Mass per core: 62g

gap width	nominal A_L (nH)	catalogue number
$\cong 0$	3700	● 4312 020 37150
0.2 ± 0.03	1000	4312 020 37160
0.5 ± 0.05	480	4312 020 37170
1.0 ± 0.1	270	4312 020 37180
2.0 ± 0.2	150	4312 020 37190

The A_L values shown above apply to the gapped core indicated, assembled with an ungapped core.

● Preferred type.

EFFECTIVE PARAMETERS

For calculating the magnetic properties of a pair of cores, the following parameters should be used.

parameter	symbol	value	unit
effective magnetic path length	l_e	114	mm
effective area of magnetic path	A_e	211	mm ²
effective magnetic volume	V_e	24 000	mm ³
core factor $\sum \frac{l}{A}$	C_1	—	mm ⁻¹

NOMINAL DESIGN DATA FOR A PAIR OF CORES

parameter	symbol	value	unit
centre pole area	A_{min}	211	mm ²
length of mean turn	l_w	85	mm

ELECTRICAL AND MAGNETIC PROPERTIES OF A PAIR OF CORES

property	temperature (°C)	frequency (kHz)	parameter	value	unit
total loss (P)	60-100	25	$\hat{B} = 200 \text{ mT}^*$	<4.6	W
saturation induction (\hat{B}_{max})	100	25	$H = 250 \text{ A/m}$	>320	mT

$\hat{B} = \frac{\sqrt{2} U}{\omega A_{min} N}$

CHOKO DESIGN CHART

For application classes I, II and III see 'Power choke design' in the Introduction.

class I		class II*			class III**			centre leg gap width mm	core halves ▲ catalogue number followed by 4312 020	
$I_M^2 L$ mJ	$N_{max} \times I_M$ A	$I_M^2 L$ mJ	$N_{max} \times I_M$ A	$I_M^2 L$ mJ	$N_{max} \times I_M$ A	$I_M^2 L$ mJ	$N_{max} \times I_M$ A	nH	mm	mm
4,68	97,5	492	66,9	727	1026	2,35	47,8	1026	0,2	37150 & 37160
6,50	133	366	102	481	83,1	4,12	596	596	0,4	37160 & 37160
8,02	155	334	124	428	105	5,65	105	516	0,5	37150 & 37170
9,63	187	276	155	337	136	7,33	136	390	0,7	37160 & 37170
12,5	235	226	204	265	184	10,1	184	297	1,0	37170 & 37170
13,9	263	201	231	232	212	11,5	212	256	1,2	37160 & 37180
16,5	306	176	274	199	255	14,1	255	216	1,5	37170 & 37180
20,1	370	147	339	162	319	17,7	319	173	2,0	37180 & 37180
21,3	394	137	362	151	342	18,9	342	161	2,2	37160 & 37190
23,5	430	127	399	138	379	21,1	379	146	2,5	37170 & 37190
26,7	487	113	455	122	436	24,3	436	128	3,0	37180 & 37190
32,7	593	93	561	99	542	30,2	542	103	4,0	37190 & 37190

Calculate N_{max} with $N_{max} = (N_{max} \times I_M) / I_M$

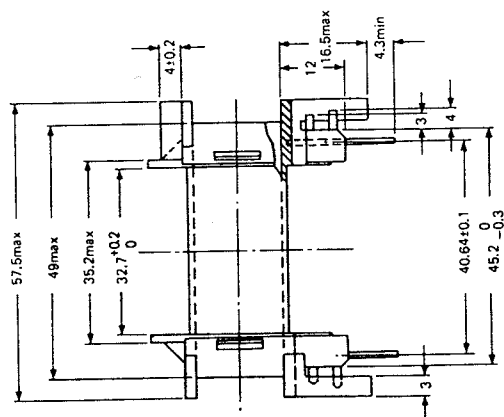
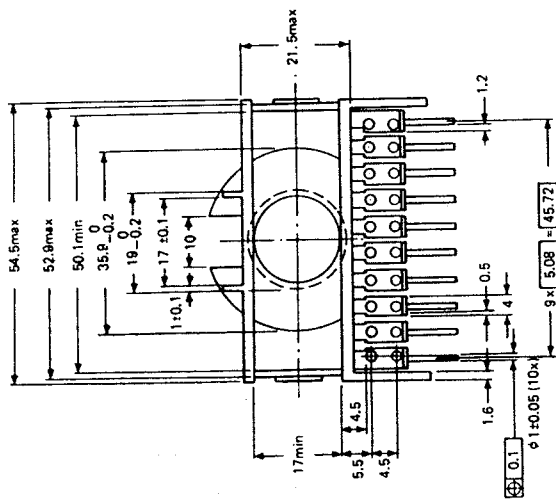
Calculate N_{min} with $N_{min} = \sqrt{L_{min} / A_{L2} \times 10^{-9}}$

▲ Preferred combinations.

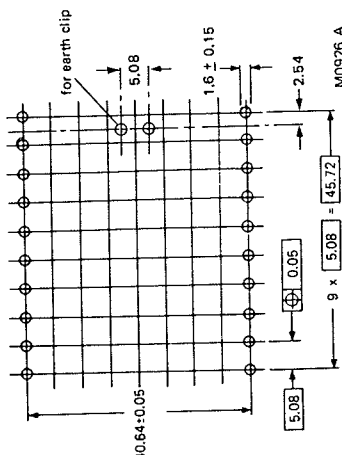
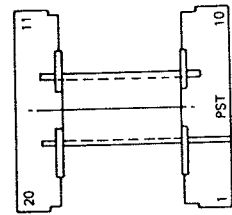
* For frequencies beyond 40 kHz enter the table at $f/40 \times I_M^2 L$ and calculate $N_{max} = (N_{max} \times I_M) / I_M \times \sqrt{f/40}$ (f in kHz).

** For frequencies beyond 10 kHz enter the table at $0,1 f \times I_M^2 L$ and calculate $N_{max} = (N_{max} \times I_M) / I_M \times \sqrt{0,1 f}$ (f in kHz).

COIL FORMER



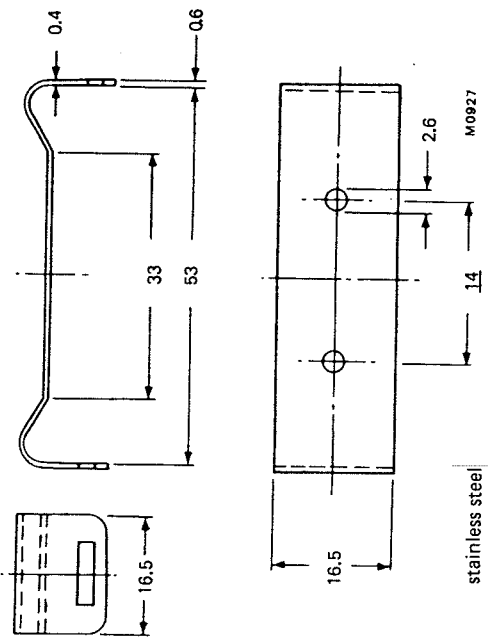
Pin arrangement



Material
 Minimum window area
 Mean length of turn
 Flammability
 Solderability
 Catalogue number

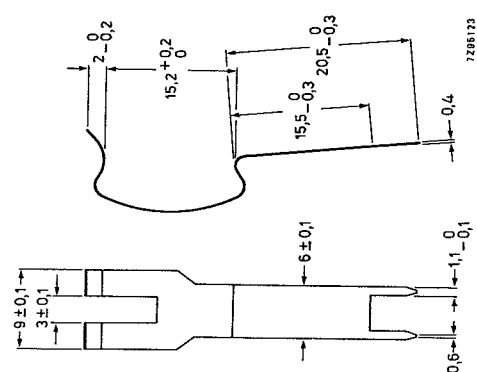
glass-fibre-filled polyterephthalate;
 20 copper-nickel alloy pins are inserted
 273 mm²
 85 mm
 according to UL94 V-0
 400 °C for 4 s
 4322 021 33880

MOUNTING PARTS



Assembly clip.
 Material
 Catalogue number

stainless steel
 4322 021 33920



Earth clip.
 Material
 Terminations
 Catalogue number

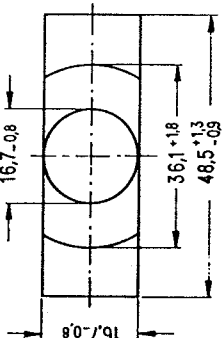
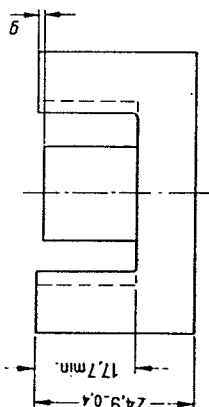
nickel silver
 hot tinned
 4322 021 33970

Both core halves can be connected to earth by means of this clip.

ETD cores are intended for SMPS transformer design with optimum weight-referred power at small volume.

A_L value versus total air gap for a set consisting of

- 1 core B66367-G-X17 (g appr. 0) and 1 core B66367-G... ($g > 0$)
- or
- 2 cores B66367-G... ($g > 0$)



Dimensions in mm

Magnetic characteristics (per set)

- Core factor $\Sigma I/A = 0.54 \text{ mm}^{-1}$
- Effective area $A_e = 211 \text{ mm}^2$
- Min. core cross-section) $A_{min} = 209 \text{ mm}^2$
- Effective length $l_e = 114 \text{ mm}$
- Effective volume $V_e = 24000 \text{ mm}^3$

Approx. weight 62 g/item

ETD cores are delivered individually and according to dimension "g" (shortened center leg). Dimension "g" applies to a core set comprising one core with "g" approximately 0 and one core with shortened center leg.

Ferrite material	Dimension "g" tolerance mm	A_L value ²⁾ (approx.) nH	Effective permeability (approx.) μ_s	Ordering code (PU: 100 items)
N27	appr. 0 -	3700	1590	B66367-G-X127
N67	appr. 0 -	3800	1630	B66367-G-X167
N27	0.2 ± 0.03	1100	473	B66367-G200-X127
	0.5 ± 0.05	540	232	B66367-G500-X127
	1.0 ± 0.1	310	133	B66367-G1000-X127
	2.0 ± 0.2	190	82	B66367-G2000-X127
N67	0.5 ± 0.05	540	232	B66367-G500-X167
	1.0 ± 0.1	310	133	B66367-G1000-X167

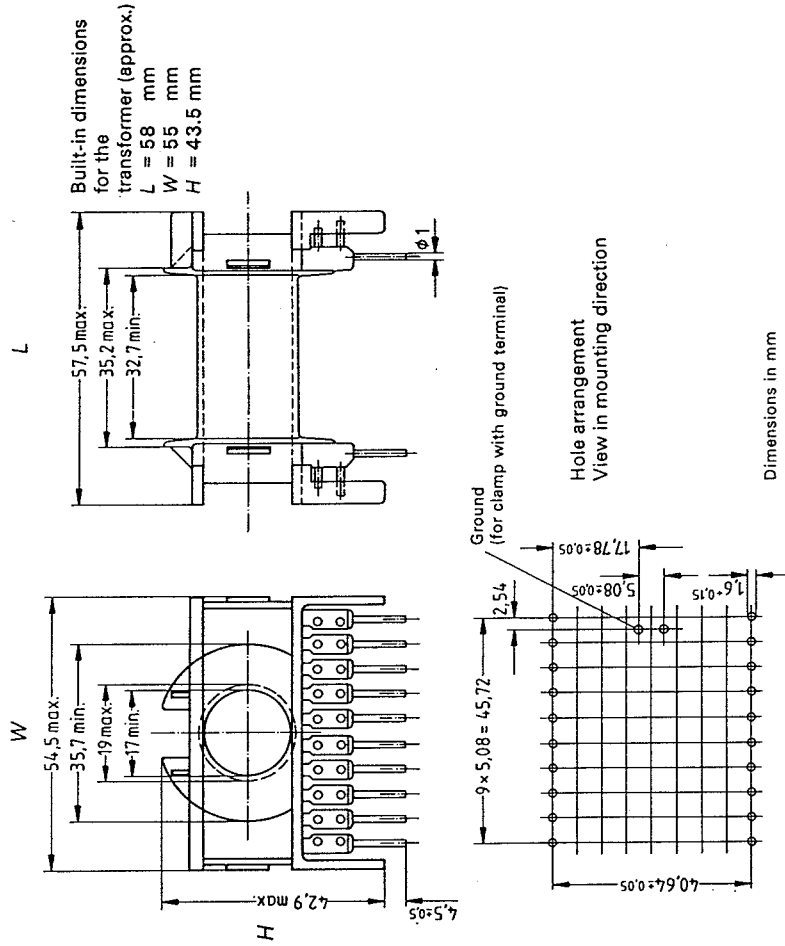
For power loss P_v and amplitude permeability μ_s refer to page 461.

1) Required to calculate the max. flux density 2) Measuring temperature 25 °C, measuring flux density $B \leq 1 \text{ mT}$
 ☒ Preferred products (refer to page 4)

Siemens

Coil former B 66368

Glass-fiber reinforced polyterephthalate coil former, flame-retardant in accordance with UL 94 V-0. Available with 20 solder terminals, also suitable for automatic winding. For solderability of terminal pins refer to page 89. For winding details refer to page 77.



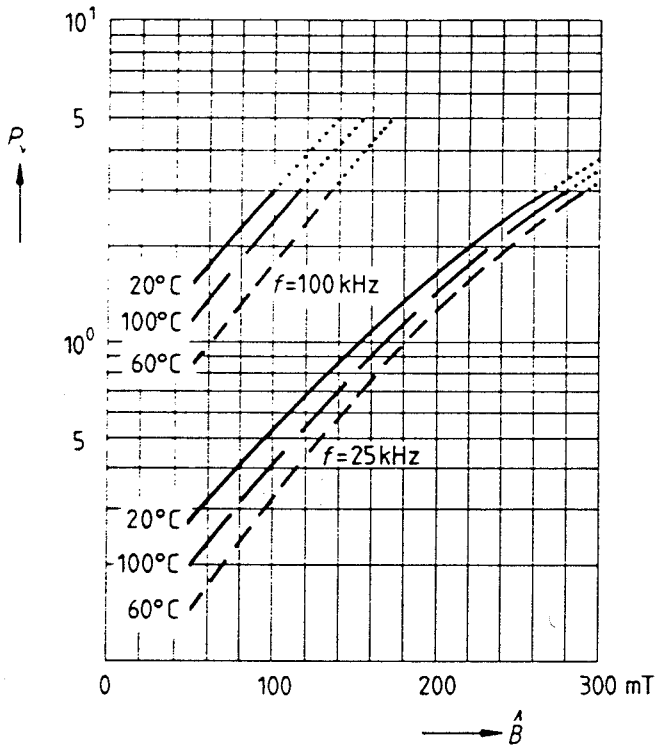
Number of sections	Useful winding cross section A_N mm ²	Average length of turn l_N mm	A_R value ¹⁾ $\mu\Omega$	Approx. weight g	Ordering code (PU: 50)
1	269,4	86	11	27	B66368-A1020-T1

1) $R_{Cu} = A_R \cdot N^2$ (dc resistance = $A_R \cdot$ number of turns²)
 ☒ Preferred products (refer to page 4)

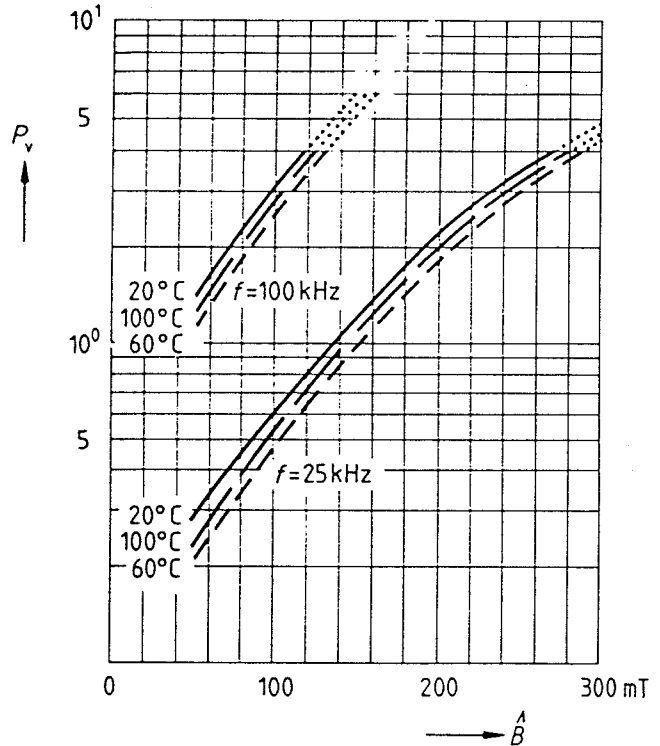
ETD Cores

Power loss for cores made of ferrite material N27 versus alternating flux density at various frequencies and temperatures (measured with ungapped core sets). Measuring method in accordance with IEC publ. 367-1.

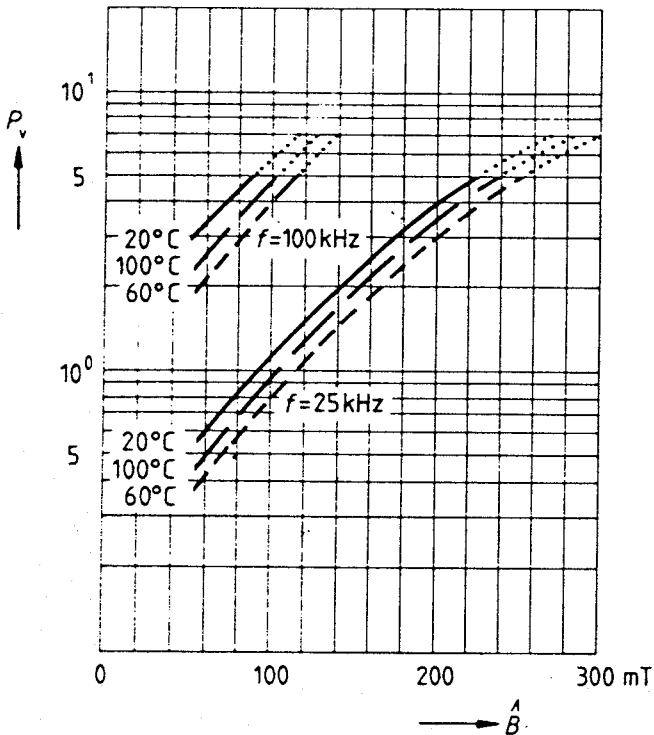
$\frac{W}{\text{set}}$ ETD 34 (B66361-GX127)



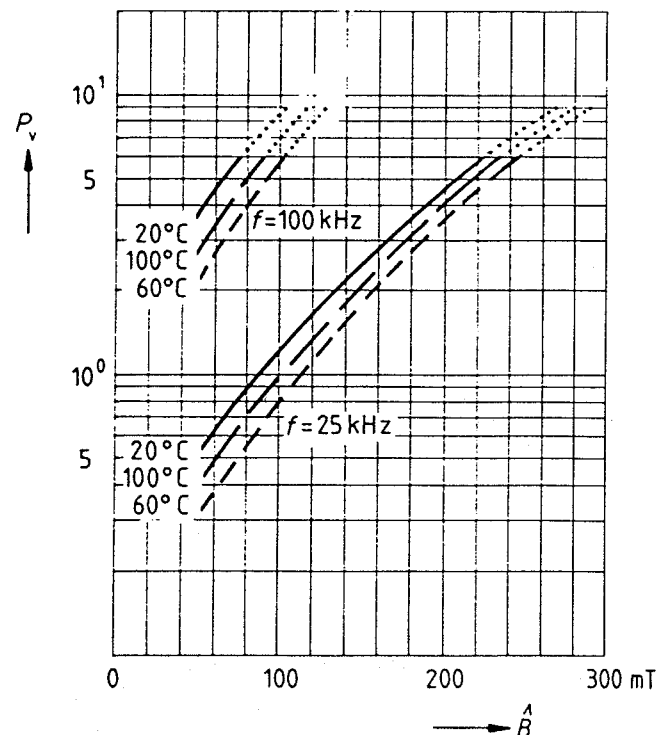
$\frac{W}{\text{set}}$ ETD 39 (B66363-G-X127)



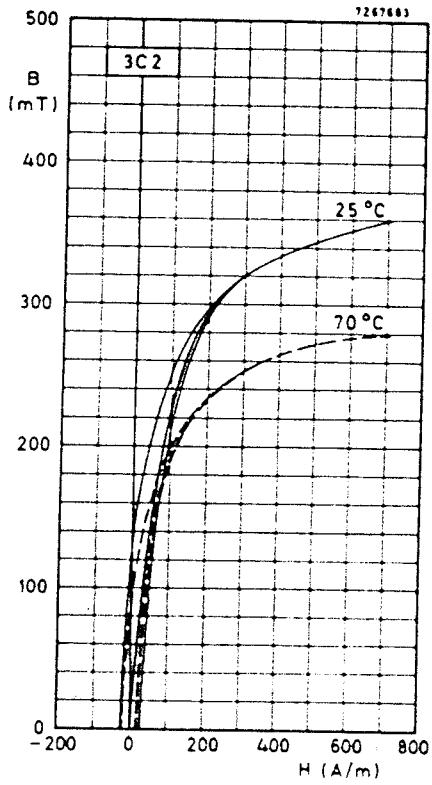
$\frac{W}{\text{set}}$ ETD 44 (B66365-G-X127)



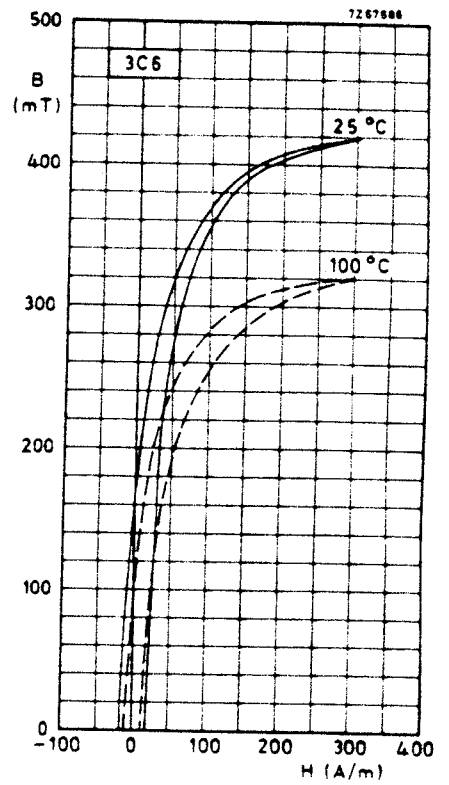
$\frac{W}{\text{set}}$ ETD 49 (B66367-G-X127)



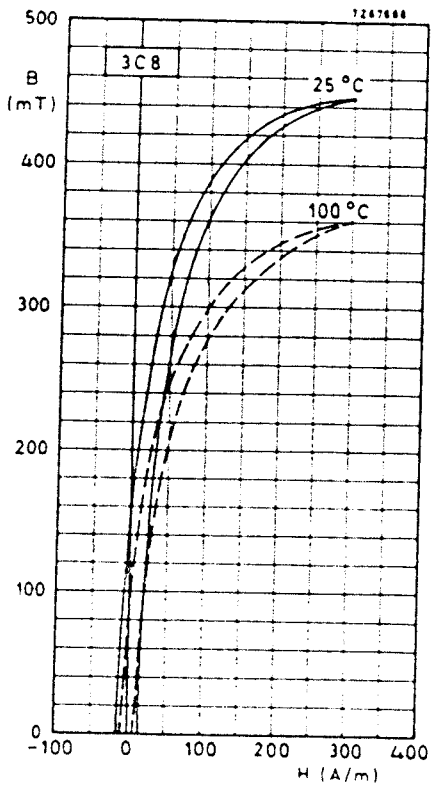
ballistic curves



ballistic curves



ballistic curves



ballistic curves

